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A Survey of *Pasteurella tularensis* Infection in the Animals of the Jackson Hole Area.[1]

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Introduction.

In a wooded wildlife area such as Jackson Hole, Wyoming, there are possibilities of the infection of human beings by tularemia, a bacterial infection caused by *Pasteurella tularensis*. It is prevalent in the Rocky Mountain and Pacific Coast regions and is especially associated with the abundance of ticks and deerflies in these areas. Since this infection is directly transmissible to man through contact with infected animals as well as through the bite of an arthropod harboring the organism, a survey to determine the prevalence of tularemia in this area was considered important. Although tularemia may be transmitted through the bites of the wood tick (*Dermacentor andersoni*), the American dog tick (*Dermacentor variabilis*), the lone-star tick (*Amblyomma americanum*), the Pacific Coast tick (*Dermacentor occidentalis*), the deer tick (*Ixodes pacificus*) and deer flies, for our purposes in the Jackson Hole area the Rocky Mountain wood tick (*D. andersoni*) is probably the only intermediate host of importance.

Tularemia is known to occur in rabbits, particularly jack rabbits, and in other rodents. Kohls and Steinhaus (1943) have reported it in the shrew, *Sorex vagrans monticola*, and the field mouse, *Microtus pennsylvanicus modestus*. Tularemia has been found in sheep by Parker and Dade (1929). Epizoötic tularemia in sheep in Montana was due entirely to the wood tick according to Philip, Jellison and Wilkins (1935). Although wild rabbits and hares have caused more than 90 per cent. of all the human cases reported in the United States, other rodents have been found to harbor the disease-producing organisms (Jellison and Parker, 1944). Jellison and his co-workers (1942) have reported epizoötic tularemia in the beaver, *Castor canadensis*. Tularemia has been contracted by human beings from the ground squirrel, tree squirrel, woodchuck, cat, dog, hog, fox, coyote, muskrat, deer, mink, raccoon, grouse and pheasant (Foshay, 1946).

The ticks may infect man not only by their bite, but also by their excrement (Parker, 1935). Davis (1943) attempted to transmit *P. tularensis* to man through the bedbug (*Cimex lectularius*), but concluded that this mode of transmission was unreliable. The same author (Davis, 1940) reported that the organisms may survive in the argasid ticks (*Ornithodoros turicata* and *O. parkeri*) for at least 674 and 701 days, respectively, but that they did not transmit the organisms during feeding.

This paper is a report of a general tularemia survey made during the summer of 1949 of the rodents and other animals in the Jackson Hole area. The results of examinations of ticks collected in this area are included. The first phase only of the tularemia problem in Jackson Hole is reported on, namely: a determination of the occurrence of tularemia in rodents and other wild animals found in this area. No studies have been made of the epidemiology.

Materials and Methods.

Various mammals were collected in the Jackson Hole area during the period of June 2 to August 20, 1949. Live traps were used where possible, but shooting and other methods of hunting were also used. In order to make a general survey, the trapping was not restricted to single species. Protected animals such as the beaver and mink were not taken unless found dead.

Upon capture of an animal, blood was drawn from the heart and a Gram stain made from a smear. The blood was also used to inoculate a blood-glucose-cystein (Difco) slant. The tubes were incubated at 37° C. for 3 to 5 days. Periodic examinations were made of the slant cultures. None of the tubes was discarded as negative until incubated two weeks. When growth occurred on the slants, Gram stains were again made to compare with the organisms originally seen in the blood.

The animal was dissected after the blood was drawn and a careful examination made of the liver, kidney and spleen to detect characteristic lesions. When these organs

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were abnormal, tissue from them was used to inoculate a blood-glucose-cystein slant and incubated for 3 to 5 days and the subsequent growth was examined after Gram staining to detect typical Gram-negative, encapsulated, pleomorphic rods.

A physiological saline solution suspension was made if tularemia-like organisms were isolated from the growth and 1 cc. of this suspension was injected intraperitoneally into a laboratory mouse. After 7 to 9 days, it died if the injected organisms were *P. tularensis*. The mouse was then autopsied and its blood used to inoculate a blood-glucose-cystein slant. If tularemia organisms were detected, the specimen was considered positive for tularemia.

The method described by Philip, Jellison and Wilkins (1935) was used in the examination of the wood ticks. Adult, unfed ticks were swept from the vegetation in the area by "flagging." The ticks thus collected gave a fairly accurate quantitative estimate of active tick populations. After a certain area or field was "flagged," the ticks collected were placed separately in glass vials, macerated with a sterile glass rod and normal physiological saline solution was added to make a uniform suspension of the organisms. The vial was corked and shaken 15 times. From this suspension a Gram stained preparation was made and examined microscopically under the oil-immersion lens. A loopful of this suspension was transferred to a blood-glucose-cystein slant and incubated for 3 to 5 days at 37° C. After the incubation period, if growth had occurred, Gram stains were made from the slants. These slides were also examined under the oil-immersion lens.

Results.

A total of 152 mammals of 15 species and 56 ticks were examined. The number examined and the number of positives are given in Table I.

TABLE I.

Mammal	*No. examined*	*No. positive*
Red-backed mouse (*Clethrionomys gapperi idahoensis*)	8	0
Jumping mouse (*Zapus princeps*)	13	2
White-footed deer mouse (*Peromyscus maniculatus artemisiae*)	22	2
Long-tailed weasel (*Mustela frenata nevadensis*)	8	0
Uinta ground squirrel (*Citellus armatus*)	23	4
White-tailed jack rabbit (*Lepus townsendii campanius*)	6	1
Uinta chipmunk (*Eutamias umbrinus*)	11	0
Wind River pine squirrel (*Tamiasciurus hudsonicus ventorum*)	31	3
Pocket gopher (*Thomomys talpoides tenellus*)	1	0
Buff-bellied chipmunk (*Eutamias amoenus luteiventris*)	10	0
Least chipmunk (*Eutamias minimus*)	11	2
Mink (*Mustela vison*)	1	1
Badger (*Taxidea taxus taxus*)	2	1
Porcupine (*Erethizon dorsatum epizanthum*)	4	1
Flying squirrel (*Glaucomys sabrinus*)	1	0

Of the 152 animals examined, there were 17 positives for tularemia, which was detected in the jumping mouse, white-footed deer mouse, Uinta ground squirel, white-tailed jack rabbit, Wind River pine squirrel, least chipmunk, mink, badger and porcupine. This is believed to be the first report of tularemia in the badger (*T. t. taxus*) and the porcupine (*E. d. epizanthum*).

Only one of the 56 ticks examined gave a positive reaction for *P. tularensis*.

Discussion.

At this time a percentage estimate of the occurrence of tularemia in the Jackson Hole region cannot be given accurately, the number of animals collected not being large enough to warrant conclusions on this point. In six species tularemia was not detected, but conclusive evidence that these species living in the Jackson Hole area do not contract tularemia is lacking. Further work in this respect is definitely necessary.

Correlation of the number of infected ticks and the number of animals with tularemia could not be established, since only one out of the 56 ticks was found to be infected.

Many of the animals diagnosed as positive for tularemia did not have enlarged spleens or focal necrosis. They were not sluggish or sick-looking, probably because they were caught while in the early stage of the infection.

According to Jellison (1949), who worked in Teton County where the Jackson Hole region is situated, tularemia should be expected to be rare, because there are no cottontail rabbits. There are, however, a number of jack rabbits and snowshoe hares, although considerably fewer than in similar areas.

Mammalogists at the Jackson Hole Wildlife Park Research Center handled and skinned during the summer a certain number of small mammals that were later detected as having had tularemia. Exposure to the disease through this work did not lead to infection, perhaps because of the low virulence of some of the *P. tularensis* strains found in resident rodents. The organisms in these rodents are the least virulent; those

found in sheep are the most virulent (Jellison, 1949).

Conclusions.

1. Tularemia may occur in the badger and the porcupine.

2. Tularemia is found in some of the rodents and other small mammals of the Jackson Hole region.

3. Tularemia has been detected in the jumping mouse, white-footed deer mouse, Uinto ground squirrel, white-tailed jack rabbit, Wind River pine squirrel, least chipmunk, mink, badger, and porcupine in the Jackson Hole region.

4. The incidence of tularemia in Teton County, Wyoming, seems to be relatively low due to the region's isolation and small rabbit population.

5. The virulence of *P. tularensis* found in rodents of this region is low and is not very likely to cause cases of human tularemia.

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